CFCC Radiant Burner Screen

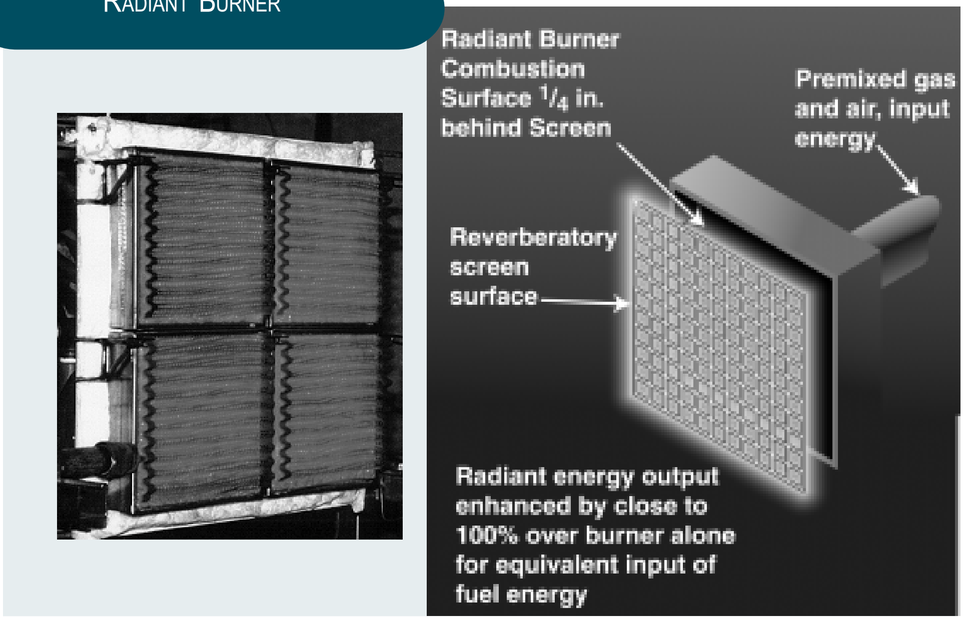
Chemical vapor infiltration (CVI) process used to fabricate CFCC radiant burner screens

The U.S. Department of Energy's Office of Industrial Technologies (OIT) initiated the Continuous Fiber Ceramic Composite (CFCC) Program in 1992 as a collaborative effort between industry, National Laboratories, universities and government.

Through support of the CFCC Program, AlliedSignal Composites, Incorporated is fabricating silicon carbide matrix CFCC components using the chemical vapor infiltration (CVI) process. The CVI process involves fabricating ceramic fiber preforms in the shape of final parts and infiltrating with chemical vapors that react at elevated temperatures to form a silicon carbide matrix on and between the fibers. Fibers such as silicon carbide are woven, braided, or wound to produce the desired shape.

AlliedSignal Composites and the Alzeta Corporation have been working together on a CVI matrix CFCC screen to be placed as a reverberatory surface above Alzeta's burners. The concept of employing a screen adjacent to a radiant burner has been known for some time. However, attempts to use high alloy steel screens for this application have met with failure due to severe corrosion and embrittlement of the metal screen. The latest CFCC screen design provides enhanced structural resistance to physical impact damage and increased radiant surface area. The screen application saves energy and significantly reduces both NOx and CO_2 emissions accompanying the more efficient use of natural gas.

Radiant Burner



Actual radiant burner (12 x 12 inches) and radiant burner schematic.

Benefits

CFCCs offer all the advantages of ceramics - resistance to heat, erosion, and chemical activity - while adding toughness and thermal shock resistance. CFCCs enable substantial increase in energy efficiency and a decrease in life cycle costs in a broad range of industrial applications. CFCC materials combined with the low emissions capabilities of radiant burners will:

- increase radiant heat output by 50% and reduce fuel consumption by 33%
- provide industry a cost-effective means to meet Clean Air Act requirements
- result in economic benefits due to longer life, increased thermal efficiency, and lower maintenance

Applications

Radiant burners are used in a wide range of applications in industrial, commercial and residential markets. Applications include warm air furnaces, water heaters, metal treating, glass forming, volatile organic chemical thermal oxidizers, fire and water-tube boilers, plastic, paper and paint drying, and process heaters. Increased radiant output is most significant in markets where direct radiative infrared heating is employed to heat, process, or dry a load. Examples of such applications are drying and curing paints, epoxies and other coatings, paper, and textiles.

Project Description

Goal: The goals of this project are to: 1) demonstrate long-term durability, life prediction capability, and cost-effectiveness of CFCC components developed by the CVI process for application in radiant burners; and 2) develop processing methods which reduce manufacturing costs and cycle time.

AlliedSignal Composites is partnering with the Alzeta Corporation to create the next generation of high-efficiency, low-emissions burner products. Radiant burner screens will be fabricated and tested at an industrial partner site for durability with respect to both thermal shock and physical impacts.

As exhibited by this project, the CFCC Program is addressing the critical need for advanced materials that are lighter, stronger, and more corrosion-resistant than metals. The Program strives to advance processing methods for reliable and cost-effective ceramic composite materials to a point at which industry assumes the full risk of development and commercialization. The long-term strategy is to develop the primary processing methods for reliable and cost-effective fabrication of CFCCs and to perform application-specific testing which will meet the needs of a wide range of energy saving applications in industry. These industries include: power generation, agriculture, aluminum, steel, chemicals, forest products, glass, metal casting, mining and refining.

Progress and Milestones

- Thermal fatigue testing of 10,000 thermal cycles to temperature and 15,000 on-off cycles has been conducted with no damage to the CFCC screens.
- Tests of 1,000 hours at temperature have been performed and were terminated since no change in the properties of the screens was noted.
- Glass processing and paper printing drying plant simulation tests were conducted using radiant burners and screens. The two small-scale plant tests were considered successful. New industrial applications are being evaluated.
- Tests with an automotive glass manufacturer demonstrated higher throughput from existing footprint furnaces with faster processing times, greater adjustability of the furnace, and lower energy costs compared to incumbent electric radiant heaters.
- Cost reduction activities for AlliedSignal Composites' enhanced SiC/SiC screens have been active and successful. Adoption of resin derived interface coatings have resulted in scale-up quantities of screens at costs that are a quarter of previous screens.
- AlliedSignal Composites, Incorporated is developing burner applications with other burner companies. They are evaluating tubular and flat CFCC screen configurations for various applications.

Project Partners

AlliedSignal Composites, Incorporated
Newark, DE

Alzeta Corporation
Santa Clara, CA

For additional information, please contact:

Phil Craig
AlliedSignal Composites, Incorporated
Phone: (302) 456-6577
Fax: (302) 456-6480
phil.craig@alliedsignal.com
www.dlcomposites.com

Debbie Haught
Office of Industrial Technologies
Phone: (202) 586-2211
Fax: (202) 586-1658
debbie.haught@ee.doe.gov

Merrill Smith
Office of Industrial Technologies
Phone: (202) 586-3646
Fax: (202) 586-1658
merrill.smith@ee.doe.gov

Visit the CFCC home page at
www.ms.ornl.gov/cfcc/home.htm

Please send any comments, questions, or suggestions to
webmaster.oit@ee.doe.gov.

Visit our home page at
www.oit.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

February 1999